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Research Article

The Effect of Urban Sprawl on Land Use Change in Mersin, Turkey

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ABSTRACT

Urbanization processes are progressing rapidly all over the world and especially affect the planning processes of developing countries negatively. Rapid urbanization resulting from the demand of the increasing population prevents controlled growth and causes land use decisions to be taken without adequate analysis. In order to continue people's lives in a healthy and self-sufficient living environment, it is necessary to ensure the sustainable use of fertile soil and all natural resources. As a result of uncontrolled growth in these areas, irreversible damage occurs to natural resources. The aim of this study is to determine the distribution of the urban texture on the natural environment and the changing area uses in the 10-year period in Mersin, one of the developing cities. For this purpose, land uses are grouped under 4 main headings as settlement, agricultural lands, forest areas and unused areas.In the 20-year period between 1998 and 2018, it was determined that the amount of urban area doubled and the total forest area decreased by 2/3 in the study area, which was approximately 35,000 hectares. As a result, it was determined that urban development caused a serious loss of agriculture and forest areas, and thus, it was emphasized that the protection of natural areas should be considered in making urban plan decisions in order to ensure urban sustainability.

Keywords: *Urban sprawl, land use, land transformation, Mersin*

Kentsel Gelişimin Arazi Kullanımları Üzerine Etkisi- Mersin Örneği

ÖZ

Kentleşme süreçleri tüm dünyada hızlı bir şekilde ilerlemekte ve özellikle gelişmekte olan ülkelerin planlama süreçlerini olumsuz etkilemektedir. Artan nüfusun talebi sonucunda ortaya çıkan hızlı kentleşme, kontrollü büyümeyi engellemekte ve alan kullanım kararlarının yeteri kadar analiz edilmeden alınmasına neden olmaktadır. Bu alanlarda kontrolsüz büyümenin bir sonucu olarak, doğal kaynaklar üzerinde geri dönüşü olmayan tahribatlar meydana gelmektedir. İnsanların sağlıklı ve kendilerine yeten bir yaşam ortamında hayatlarına devam edebilmeleri için verimli topraklarının ve sahip oldukları tüm doğal kaynakların sürdürülebilir kullanımının sağlanması gerekmektedir. Bu çalışmanın amacı gelişmekte olan kentlerden Mersin örneğinde 10 yıllık süreçlerde kentsel dokunun doğal çevre üzerindeki dağılımı ve değişen alan kullanımlarının tespit edilmesidir. Bu amaçla arazi kullanımları, yerleşim, tarım arazileri, ormanlık alanlar ve kullanılmayan alanlar olmak üzere 4 ana başlık altında toplanmıştır. 1998-2018 yılları arasındaki 20 yıllık süreçte, yaklaşık 35.000 hektar olan çalışma alanında, kentsel alan miktarının iki katına çıktığı, toplam ormanlık alanın ise 2/3 oranında azaldığı tespit edilmiştir Sonuç olarak kentsel gelişimin ciddi oranda tarım ve ormanlık alan kaybına yol açtığı belirlenmiş ve böylece kentsel sürdürülebilirliğin sağlanması için kentsel plan kararlarının alınmasında doğal alanların korunmasının gözetilmesi gerektiği vurgulanmıştır.

Anahtar Kelimeler: *Kentsel gelişim, arazi kullanımı, arazi önüşümü, Mersin*

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I. INTRODUCTION

Humans modify themselves on earth trying to adapt to conditions in various situations since the last ice age [1-2-3]. Many ecosystems are under pressure directly or indirectly under the influence of human beings [1-4]. Urban sprawl is used to mean unplanned development towards areas with low urban density. There are no basic municipal services in low density urban areas, and as a result of the development direction, services are shifted to these regions [5-6]. In the historical process, the population has increased in these areas depending on urban production and its effects are carried beyond borders with a spread of environmental problems [7-8].

Urban sprawl emerges as an area use, which is also used in the sense of uncontrolled development and is generally observed in industrialized countries [9]. This spread is closely related to the agricultural areas around the rapidly developing cities. The fertile agricultural lands in these regions are transforming into rapidly changing and transforming areas due to economic concerns. Urban sprawl has put pressure on water resources, forests and the areas surrounding urban areas. Loss of fertile soil has economic and ecological consequences. Besides, it decreases the self-feeding potential of countries and causes them to become dependent on the outside. Urban sprawl in agricultural areas has become a global phenomenon that concerns every country in the world. This situation causes the depletion of agricultural lands in many countries of the world, especially in developing countries, with the effect of the rapidly increasing population [10].

In the 1900s, 9% of the world's population lived in urban areas, this rate was 40% in 1980 and it increased to 50% in 2000 [8]. Today, 55% of the world's population is reported to live in urban areas. This ratio is projected to increase to 68% by 2050. [11]. Turkey's population was 71.5171 million in 2008 and increased to 82 003 882 in 2018. Moreover, while 75% of Turkey's population was living in cities in 2008, this proportion had risen to 92.3% in 2018.

In the historical process, the unplanned growth of urban cities called urban sprawl has gained the great interest of urban researchers. Urban growth poses many problems arising from the loss of fertile land. The impacts of urban growth can be approached in two parts, human quality of life and environmental conditions. The main factor affecting human quality of life is the increasing population in urban areas. Migration resulting from unemployment in rural areas and limited social facilities, increasing industrialization in cities, imbalance product prices in agricultural lands increase the population of urban areas. Basic needs such as infrastructure, transportation and social facilities are not enough for this growing population. In parallel with the increasing population, the need for living space has increased and usage area per capita has decreased in urban areas. The amount of living space per capita decreases the amount of green areas will be reduced and this will adversely affect people's quality of life. [7-12-13-14].

II. MATERIAL AND METHOD

A. STUDY AREA I

The research area consists of the central districts of Mersin (Akdeniz, Toroslar, Yenişehir, Mezitli) located at 32 56 'and 35 11' east longitudes, 37 26 'and 36 01' north latitudes in the east of the Mediterranean region. It has a coastal plain to the Mediterranean Sea and surrounded by the Taurus Mountains. According to the population, Mersin is the 10. crowded city of Turkey, besides according to the area, 9. largest city of Turkey with 15.853 km² area. Mersin is one of the fastest-growing regions of Turkey. In the 1870s it was an accident with 8047 inhabitants, 57 years later, in 1927, the population of the central district of the province of Mersin reached 47.000, thus becoming one of the important cities of the Mediterranean [15]. The population reaches 1.814.468 in 2018 [16].

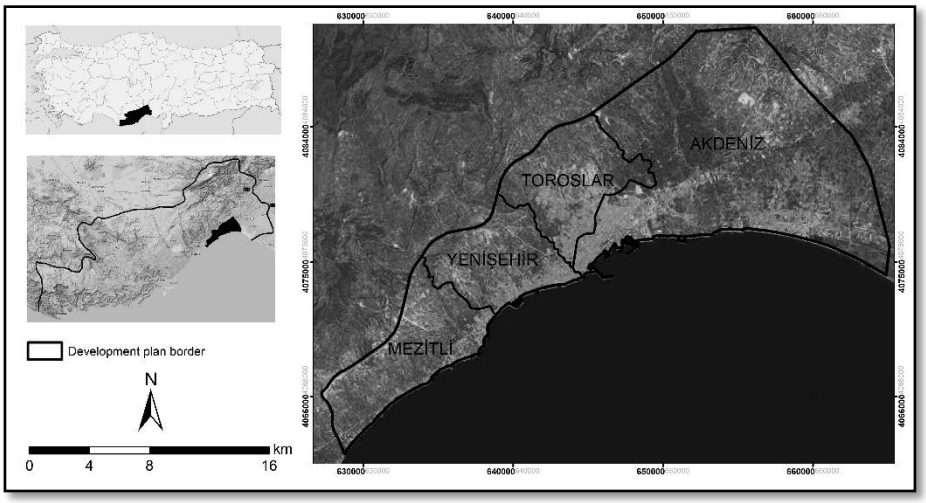

Figure 1. *Location of study area*

The city of Mersin was carrying a structure like an agricultural center at the beginning of the 1950s, it had an economic structure including domestic and foreign trade, industry, service and tourism sectors in time. In the development process, the economic, demographic, social, cultural and spatial structure of the city has also changed continuously. Mersin is a very important attraction in terms of tourism with its 320 km coastline and clean sea. Mersin has temperate climate conditions, fertile agricultural lands and large forest areas.

In the 1970s, the housing construction increased significantly started from the coastal band while transportation networks developing in this region. Mersin, which has developed in the positive a direction with the increase of industrial and commercial facilities around the Mersin-Adana highway, began to destroy its fertile lands. Today, it is observed that this development of the plain of the city is not healthy enough. This development, which destroyed thousands of ha of fertile agricultural land, brought about unhealthy urbanization and new environmental problems.

The post-1980 planning and implementation process did not produce decisions to direct and reduce this pressure. In particular, the pressure supported by the second housing development in the western development corridor has led to the opening of fertile agricultural land for housing use in some places. Plans produced in and around the city of Mersin have not considered agricultural areas as a part of urban life and urban economy, and agricultural potential has been pushed against the urban development alternatives. The transforming of agricultural areas to the settlement consumes the natural resources of the city and adversely affects its sustainability in the economic sense.

In 90's Mersin won the metropolitan status and divided three municipalities. The city of Mersin has changed its administrative status as a metropolitan area and it was divided into three sub-municipalities in terms of administrative and spatial [17]. In this period, new zoning plans came into force in the municipalities and the development of the second residence has continued to increase in the north and northwest of the city. The unplanned development effects that have continued since those days make a pressure on the fertile lands of Mersin.

When the research area of Mersin city center and its surroundings is examined, it can be said that agricultural areas are predominantly used. The favorable agricultural conditions of the Çukurova Region are valid for the Mersin region. 25% of the land in Mersin is composed of agricultural land. A significant portion of these agricultural areas is located in the vicinity of the city center and on the coastline. 83% of the research area is covered with agricultural areas. Most of the agricultural areas are mainly citrus fruits. The transformation of citrus orchards into residential areas for tourism purposes is a common occurrence in the region. The urban development of Mersin also plays an important role in the destruction of fertile lands.

This study has been prepared in order to determine the fertile lands occupied by the urban texture with the unhealthy urbanization that emerged as a result of this transformation and the new environmental problems that came with it. The future of the city of Mersin goes through the protection of agricultural areas. The agricultural vision in the Mersin region should aim to reverse this development.

B. LAND USE CHANGE CLASSIFICATION II

A geographical information system was used to determine land use change of the study area. Satellite images taken at 10-year time intervals (1998, 2008, 2018) were used for land-use calculations with the help of GIS (Geographic Information Systems). Landsat 5 dated 13/11/1998 satellite image was used for vector digitalization of year 1998, Quick Bird satellite image with 0.6m resolution was used for the year 2008 and Landsat 8 satellite view dated 05/11/2018 was used for the year 2018. Satellite image data converted to vector format by manually digitizing with correction by current environmental plans, satellite images and land studies. ArcGIS 14.1 program was used for the processing and classification of all these satellite image data. In the vector data, the intersecting and dissociating areas were fragmented and the transitions between uses were determined with the "intersect" command in ArcGIS 14.4.

III. THE RESEARCH FINDINGS

Land use changes were obtained by digitizing the satellite images of the years 1998, 2008 and 2018. Land uses were collected in 4 headings by comparing land uses in 10 year time period to determine the damaged lands; build-up area, farmland area, forestland area and unused area. The changes resulting from the classifications are shown in Figure 2.

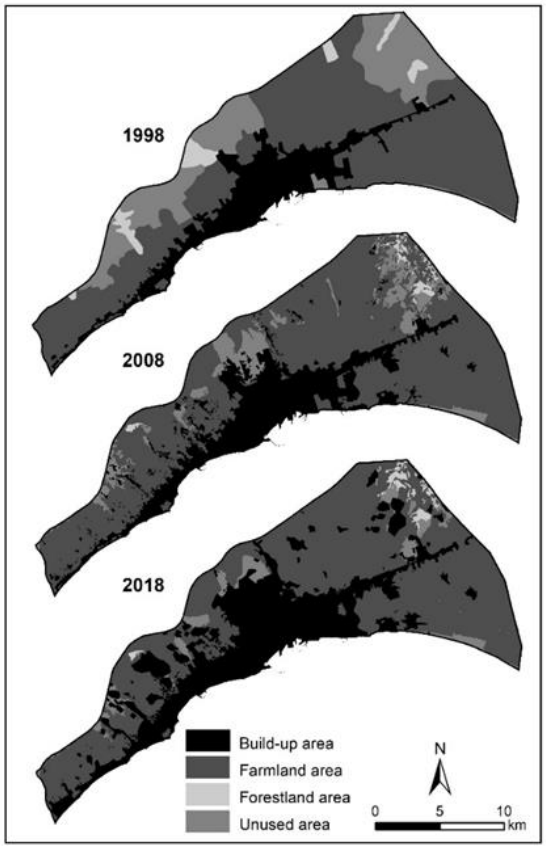

***Figure 2**. The land use distribution between 1998-2018.*

Generally, the build-up area is seen as the most improved area especially in 2018 (Figure 2). Also, unused areas are transformed into other uses, farmland. Table 1 is prepared to explain land-use changes and each use conversion to another. The land-use changes divided into 10-year periods. Land changes and transformations for each use are expressed in the hectare unit for every ten years. As shown in the table, for each area "from" and "to" statements are used to signify the conversions. The purpose of this calculation is that there are gains and losses to the 10-year process specified for each use. In this context, "to" means losing and "from" means gaining land area for each use.

Table 1. *Land use inter-domain changes between 1998 and 2018*

	Build-up area	**Farmland area**	**Forestland area**	**Unused area**
1998	**5 817,54**	**20 359,51**	**1 209,19**	**7 553,46**
to build-up area	-	1 364,96	2,73	401,15
to farmland area	0	-	965,11	4 351,59
to forestland area	0	0	0	293,18
to unused area	0	834,04	126,98	-
from build-up area	-	0	0	0
from farmland area	1 364,94	-	0	834,04
from forestland area	2,73	965,11	-	126,98
from unused area	401,15	4 351,59	293,18	-
2008	**7 586,38**	**23 477,21**	**407,55**	**3 468,56**
to build-up area	-	2 721,64	2,38	1 016,78
to farmland area	0	-	137,82	783,53
to forestland area	0	115,31	-	92,46
to unused area	2,00	185,39	7,50	-
from build-up area	-	0	0	2,00
from farmland area	2 721,64	-	115,31	185,39
from forestland area	2,38	137,82	-	7,50
from unused area	1 016,78	783,53	92,46	-
2018	**11 325,18**	**21 376,22**	**467,62**	**1 770,68**

When Table 1 is examined that showing the area changes in Mersin city, it is seen that urban areas have increased 50% in the first 10 years and 50% in the second 10 years. In both intervals, it is seen that the most increasing area is from the transformation of the agricultural land. When the transformation process of agricultural lands is examined, it is seen that the areas lost have turned into residential areas. However, there is a remarkable point about agricultural areas. Besides to lost agricultural fields, the amount of land transformed into agricultural areas from empty areas is quite high. For this reason, it is observed that the total agricultural area has increased as a result of the 20-year period. In forest areas, the situation is more remarkable. Especially in the first 10 years, it is seen that the biggest loss of land has turned into agricultural land. As a result of 20 years, it is noteworthy that the land uses that have turned into forest areas are less. When the unused areas are examined, it is seen that more than half of the existing area has turned into agricultural land, especially in the first 10 years. The transformations continued in the second 10 years and the unused areas have largely transformed into different land uses (Figure 3).

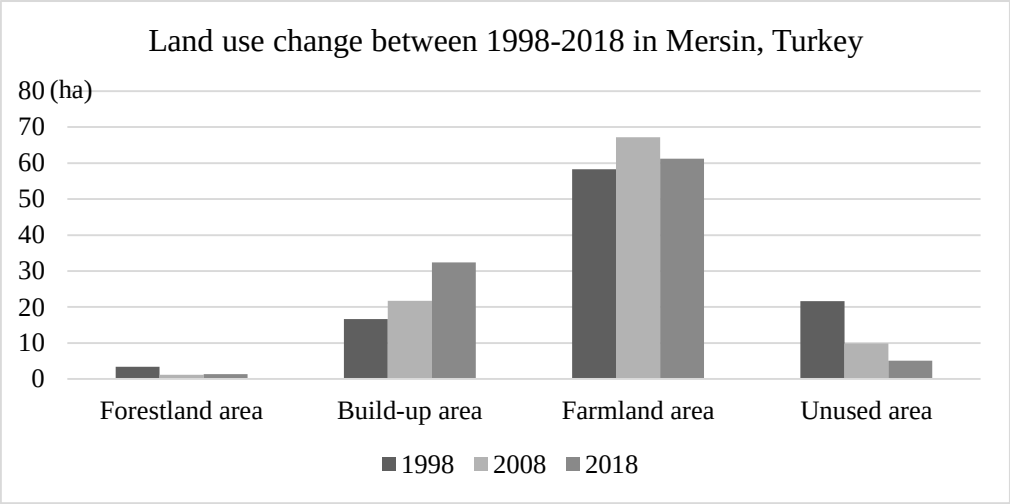

***Figure 3**. Land-use change between 1998-2018 in Mersin, Turkey*

The findings of this study are given in various tables and figures. This study aims to reveal land-use changes in Mersin and to determine the destruction of fertile areas. First of all, farmland areas and forestland areas should be protected to ensure a sustainable environment with healthy and sufficient natural resources and be transferred to future generations. Besides, the built up areas should be planned away from the productive areas. For this purpose, the identified changes are interpreted as positive and negative according to their transformations. The definition of land-use conversions of the study area is given in Table 2.

***Table 2.** Land use conversions*

1998-2018	build-up area	farmland area	forestland area	unused area
Build-up area	0	+	+	+
Farmland area	-	0	+	-
Forestland area	-	-	0	-
Unused area	-	+	+	0

When Table 2 is examined, (+), (-) and (0) marks are seen. (+) indicates that the change in this intersection is favorable in terms of efficient areas, (-) significance that there is a negative change in the productive area, and (0) expresses that there is no change in the area. The land-use change map generated according to Table 2 is given in Figure 4.

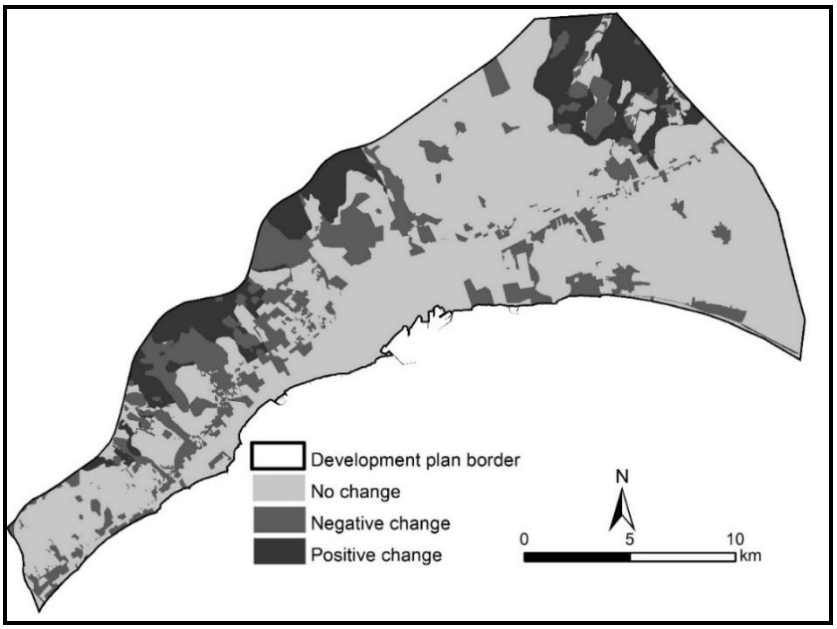

Figure 4. *Land-use change in the research area*

According to this figure, 12,51% of this area (4368,24 ha) changed positively, 19,60% of the land (6 849,53 ha) changed negatively and 67,89% of the land (23 721,93) preserves the current situation.

Table 3. *Transformation ratios of land uses*

1998-2018	**Total**	***%***
No change	23 721,93	67,89
Negative change	6 849,53	19,60
Positive change	4 368,24	12,51
Total	**34 939,70**	**100**

The results of the 20-year change examined are quite remarkable in a coastal city built on fertile lands like Mersin. Negative changes continue on the coastline of Mersin, which does not currently have agricultural land and has a second residence density. However, there is no change in the city center which has completed its development. As can be seen in Figure 3, the general changes in the city have taken place in the north and North West regions. Although there are negative changes in the north of the city, these are mostly highland places used in summer because this region is more mountainous than other places. Although this change in the plateau spaces may be due to the increase in the urban population, it is due to the tendency of the people who are accustomed to urban routines to concrete construction even in summer spaces. Negative and positive changes form a different blend in the most striking northwestern part of the city.

IV. CONCLUSION

As a result of the study, the transformation process that Mersin has undergone in the last 20 years regarding land use for agricultural areas, forested areas, residential areas and bare areas has been examined. In order to determine these changes, the land use distributions between 1998-2008-2018 were mapped and the rate of change of these distributions was calculated. According to Table 1 given in the research findings as a result of the calculations between 1998 and 2008, residential areas increased by 31.41%, agricultural areas increased by 15.31%, while forest areas decreased by 66.30% and other areas by 54.07%.

Residential areas increased by 49.28%, forest areas increased by 14.73% between 2008-2018, while agricultural areas decreased by 8.95% and other areas by 48.95%.In the twenty-year change between 1998 and 2018, the areas that showed the highest decrease are other areas of use with 76.55% and forest areas with a rate of 61.32%. In this case, residential areas and agricultural areas have increased. Housing areas increased by 94.67% and agricultural areas increased by 5%. As seen in Table 1, when the land cover changes over the 20-year period are examined, it is seen that there is a relationship between the change of agricultural areas and the change of residential areas. When the rates of change by years are examined, it is seen that the agricultural areas have increased, but it has been determined that the existing agricultural areas have disappeared in the process. If the increase in residential areas continues at this rate, it will pose a threat in agricultural areas as well as in forest areas and other areas of use, so urban development processes must be taken under control.

In this context, the following objectives and strategies should be put forward for agriculture;

- Developments in agricultural areas should be restricted, new developments should not be allowed, and plan decisions from the past should be changed.
- The agricultural areas in the periphery of the city should be protected and become part of urban ecology.
- The protection of agricultural areas to a certain extent is important for the employment of local people and also for the protection of local values.
- Public institutions and organizations (municipalities etc.) be aware of the threats posed by urban sprawl and take the necessary legal and administrative measures.
- The urban sprawl is an important threat to fertile lands that need urgent action.
- It is not too late to make the right plan decisions with increasing levels of population because of the presence of fertile land in Mersin.

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